a. providing a batch of nanoparticles having submicron sizes and an electrical characteristic;

b. depositing the nanoparticles onto a surface;

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c. sintering the batch of nanoparticles to form at least one layer of an electrical device; and

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d. positioning a biological material to be in electrical communication with at least one layer of said electrical device to facilitate an electrical measurement thereof, the electrical measurement being affected by the biological material.

28. (Once amended) The method of claim 26 in which said electrical device is a transistor comprising a semiconductor layer disposed between a source element and a drain element, and depositing the nanoparticles onto a surface includes depositing the nanoparticles onto the semiconductor layer.

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REMARKS

Initially, claims 1–30 were presented for examination. In response to a restriction requirement mailed from the Office on September 13, 2001, claims 1–21 and 24–30 were elected for prosecution without traverse. In response to a second restriction requirement mailed from the Office on December 19, 2001, claims 1–16, 19–21, and 24–30 were elected as a generic invention and a species invention for prosecution without traverse. In the Office action of May 8, 2002, the Examiner indicated that claims 14–25 and 29–30 are drawn to non-elected inventions and will not be considered. Upon entry of this paper, claims 1–13 and 26–28 will be pending in this application.

Basis for the amendments to claims 1–3, 7, 9–11, 26, and 28 may be found, for example, in original claims 1–3, 7, 9–11, 26, and 28 and at pages 9–13 and Figures 1–2 of the specification. Basis for the amendment to the specification on page 13 may be found, for example, in Figure 3. Applicants submit that no new matter has been introduced by these amendments. Moreover, Applicants note that the amendments to the claims were made solely to clarify the scope of the present invention, and not for reasons related to patentability.

Rejection of Claims under 35 U.S.C. § 112

Claims 7 and 28 were rejected under 35 U.S.C. § 112, first paragraph, as based on a disclosure that is not enabling. Claims 9–11 were rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claims 1–13 and 26–28 were rejected under 35 U.S.C. § 112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention.

Applicants submit that claims 1–13 and 26–28, as amended, now comply with 35 U.S.C. § 112.

Request for Information

The Examiner requested copies of references cited in Applicants' application. These references are submitted herewith, along with an Information Disclosure Statement, a PTO-1449 form, and the required fee.

Rejection of Claims under 35 U.S.C. § 103(a)

Claims 1–13 and 26–28 are rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,605,662 to Heller et al. ("*Heller*") in combination with U.S. Patent No. 6,303,943 to Yu et al. ("*Yu*") and U.S. Patent No. 3,865,550 to Bott et al. ("*Bott*").

The primary reference cited against the application is *Heller*. That patent describes a microelectronic device that can electronically control the transport and attachment of specific binding entities to specific micro-locations. The Examiner relied on this publication for teaching "associating" biomaterial and an "electrical measurement [being] affected by" biomaterial, as recited in independent claims 1 and 26, prior to amendment. The Examiner concedes that *Heller* does not teach the use of nanoparticles with biomaterial shells, as recited in independent claim 1, nor does he teach sintering the particles as recited in independent claim 26. The Examiner relies on *Yu* and *Bott* to supply these elements, respectively.

In fact, not only does *Heller* not teach nanoparticles with biomaterial shells, but *Heller* also does not refer to nanoparticles in general, a feature recited in each step of claim 1, and in

three of the four steps of claim 26. Rather, *Heller* teaches a microelectronic device for carrying out molecular biological reactions. In accordance with *Heller*, various microlocations of the device are filled with specific binding entities (see, e.g., col. 15, line 56 – col. 16, line 14). Biological material is subsequently transported to the microlocations, where various reactions may take place (see, e.g., abstract). *Heller* does not teach forming shells of biological material around nanoparticles and then causing the deposited nanoparticles to be in electrical communication with at least one electrical contact, as recited in amended claim 1. *Heller* also does not teach positioning biological material to be in electrical communication with at least one layer of an electrical device formed by the sintering of nanoparticles, as recited in amended claim 26.

Yu, on the other hand, teaches the formation of organic photodetectors including, e.g., nanoparticles. But *Yu* does not teach forming a shell of biological material around a nanoparticle, as recited in amended claim 1. Rather, he teaches, in an example, nanoparticles dispersed in an organic film for use with a photodiode, or the blending of nanoparticles with an organic photosensing material (column 19, line 58 – column 20, line 8).

Nor does *Bott* provide what is missing in *Heller*. *Bott* merely teaches sintering round particles about 1 micrometer in diameter to remove touch contacts between the particles, thereby forming an activated metal oxide semiconducting gas sensitive element (see, e.g., col. 2, lines 28–48, and column 5, line 54 – column 6, line 39). *Bott* does not teach sintering nanoparticles to form at least one layer of an electrical device, with biological material subsequently being positioned to be in electrical communication with the layer, as recited in amended claim 26.

Accordingly, even if *Heller* were combined with *Yu* and *Bott* as the Examiner proposes, the subject matter of claims 1 and 26 still would not be realized; the references, alone or in combination, simply do not teach combining nanoparticles with biological material in order to facilitate electrical measurements that are affected by the biological material. But we submit that the combination is, in any event, improper. Insofar as *Heller* does not even mention nanoparticles, much less nanoparticles relevant to the claims herein, there exists no motivation to combine the reference with *Yu* and/or *Bott*; indeed, the latter reference also does not pertain to nanoparticles as defined in the present specification.

Applicants submit that, for at least the foregoing reasons, independent amended claims 1 and 26, and the remaining claims which depend thereon, are patentably distinct over the cited references, which neither teach nor suggest Applicants' claimed invention.

CONCLUSION

In light of the foregoing, Applicants respectfully submit that all claims are now in condition for allowance.

Please charge any fee occasioned by this paper to our Deposit Account No. 20-0531.

Respectfully submitted,

Date: September 9, 2002
Reg. No. 44,381

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MARKED-UP COPY OF AMENDED PORTION OF SPECIFICATION

Replace the paragraph located on page 13, line 17 – page 14, line 13 with the following paragraph:

FIG. 3 illustrates formation of a single-electron transistor (SET). Like chem-FETs, SETS can detect the absorption of charged material. The advantages of SETs are, first that the gate is on the length scale of single molecules, and second, that the charge sensitivity is several orders of magnitude greater. In accordance with this approach, illustrated in FIG. 3, a SET 300 is self-assembled by binding a single nanoparticle [~~310~~] 330 between two conducting contacts 315, 317. The contacts may, for example, be synthesized carbon nanotubes with modified chemical ends such that the nanoparticle self assembles onto them. Alternatively electrodes may be formed by printing conductive nanoparticles or by conventional photolithographic or other means and then employing electromigration, electroplating or electrofusing under feedback control to realize the nanoscale electrode spacing required for single electron transistor operation. Thus formed, contacts 315, 317 are exposed to a solution of nanoparticles having capping groups and, radiating therefrom (typically as a tangle of minute threads), biomolecules of interest. The interelectrode spacing distance approximates the size of the nanoparticles, so that a single nanoparticle can lodge between the electrodes and bridge them. Reagents affecting the biological material may be directly adsorbed onto (or absorbed into) the nanoparticle, and the effect monitored by operation of the device.

MARKED-UP COPY OF AMENDED CLAIMS

1. (Once amended) A method of fabricating a biolectronic component, the method comprising the steps of:

a. providing a batch of nanoparticles having submicron sizes and an [~~selected~~] electrical characteristic;

b. attaching at least one biological material to the nanoparticles so as to form shells of the biological material therearound;

c. depositing the nanoparticles onto a surface; and

d. [~~associating~~] causing the deposited nanoparticles to be in electrical communication with at least one electrical contact to facilitate an electrical measurement thereof, the electrical measurement being affected by the biological material.

2. (Once amended) The method of claim 1 in which the nanoparticles [~~associate~~] are caused to be in electrical communication with said electrical contact by [~~means of~~] self-assembly.

3. (Once amended) The method of claim 1 in which the nanoparticles [~~associate~~] are caused to be in electrical communication with said electrical contact by [~~means of~~]electrostatic assembly.

7. (Once amended) The method of claim 1 wherein the component is a transistor comprising a source element and a drain element and a semiconductor layer disposed between the source and the drain elements, and depositing the nanoparticles onto a surface comprises depositing the nanoparticles onto the surface of the semiconductor layer.

9. (Once amended) [~~The~~] A method [~~of claim 1 further~~] for fabricating a biolectronic component, the method comprising the steps of:

[e]a. providing a [~~second~~] first batch of nanoparticles having submicron sizes and a [~~selected~~] first electrical characteristic;

[f]b. depositing the [~~second-~~]first batch of nanoparticles onto a surface; [~~and~~]

[g]c. sintering the [~~second~~]first batch of nanoparticles to form a continuous, uniform layer exhibiting the [~~second batch selected~~] electrical characteristic of the first

batch of nanoparticles, the layer having a surface;[~~, the nanoparticles surrounded by the biological material being deposited onto the layer surface~~]

d. providing a second batch of nanoparticles having submicron sizes and a second electrical characteristic;

e. attaching at least one biological material to the second batch of nanoparticles so as to form shells of the shells of the biological material therearound;

f. depositing the second batch of nanoparticles onto the layer surface formed by the first batch of nanoparticles;

g. causing the deposited second batch of nanoparticles to be in electrical communication with at least one electrical contact to facilitate an electrical measurement thereof, the electrical measurement being affected by the biological material.

10. (Once amended) The method of claim 9 further comprising the step of forming [~~the~~] an electrical contact[s] according to steps comprising:

prior to steps (d) – (g),

[~~h~~]i. providing a third batch of electrically conductive nanoparticles having submicron sizes;

[~~i~~]ii. depositing the third-batch nanoparticles in contact with the layer derived from the [~~second~~]first batch of nanoparticles; and

[~~j~~]iii. sintering the third-batch of nanoparticles to form the electrical contact[s],

wherein the subsequently deposited second batch of nanoparticles is caused to be in electrical communication with the electrical contact[~~the contacts being in contact with the nanoparticles surrounded by the biological material following deposition thereof~~].

11. (Once amended) The method of claim 10 further comprising the steps of repeating steps (a)[-] –([~~j~~]g) and (i) – (iii) at a plurality of locations on a substrate to form an array of bioelectronic components.

26. (Once amended) A method of fabricating a bioelectronic component, the method comprising the steps of:

a. providing a batch of nanoparticles having submicron sizes and an [~~selected~~] electrical characteristic;

b. depositing the nanoparticles onto a surface;

c. sintering the batch of nanoparticles to form at least one layer of an electrical device; and

d. [~~associating~~]positioning a biological material to be in electrical communication with at least one layer of said electrical device to facilitate an electrical measurement thereof, the electrical measurement being affected by the biological material.

28. (Once amended) The method of claim 26 in which said electrical device is a transistor comprising a semiconductor layer disposed between a source element and a drain element, and depositing the nanoparticles onto a surface includes depositing the nanoparticles onto the semiconductor layer.